Facility name Big River Mine Tailings

Location Near Desloge, Missouri

EPA Region Region VII

Person(s) in charge of the facility Marvin Hudwalker, Hudwalkers & Associates Eng

C G Mattsson, St Joe Minerals Corp

Bryant AuBuchon, Landfill Manager

Name of Reviewer Bob Overfelt Date 3/7/88

General description of the facility

(For example landfill surface impoundment pile container types of hazardous substances location of the facility contamination route of major concern types of information needed for rating agency action etc )

The Big River Mine Tailings site is approximately 600 acres of Pb, Cd, and Zn rich mine tailings that are uncontrolled The site is bordered on three sides by the Big River and is located in St Francois County near Desloge, Missouri The tailings are sand and silt size, unconsolidated and very permeable There is also an active landfill on 60 acres of the site The nature of the tailings material and the on-site landfill make all contamination routes a major concern

Scores $S_M$ = 58 4 $S_{gw}$ = 83 8 $S_{sw}$ = 10 9 $S_a$ = 55 4)

$S_{FE}$ = Not evaluated

$S_{DC}$ = 50

**FIGURE 1**
**HRS COVER SHEET**

REGION VII FIT
PRELIMINARY ASSESSMENT
HRS EVALUATION WORKSHEET

Site Name Big River Mine Tailings City Desloge, Missouri

WST #07M00616 Site #Y60 CERCLIS #MOD981126899

Major Contaminant(s) Lead (Pb), Cadmium (Cd), and Zinc (Zn)

| Scoring Scenarios | Current Score | Highest Score |
|---|---|---|
| Ground Water Route (Sgw) = | 83 8 | 90 0 |
| Surface Water Route (Sw) = | 10 9 | 21 8 |
| Air Route (Sa) | 55 4 | 69 2 |
| Total Score (Sm) | 58 4 | 66 8 |

Potential Releases (Probability)

(H) M L - Ground Water
(H) M L - Surface Water
(H) M L - Air
(H) M L - On-Site/Direct Contact

HRS-2 Comments

Ground Water Route Hydraulic conductivity and travel time for water in the saturated and unsaturated zones could be determined from the existing monitoring wells

Surface Water Route If biological sampling results and the population associated with recreational use were considered this score would be increased Certain fish in the Big River are known to have elevated levels of Pb in their edible tissue as a result of contamination of the river by Pb, Cd, and Zn rich mine tailings from the site

Air Route A comprehensive source sampling effort must be performed in order to document an air release

On-Site Route Additional soil sampling may be required to document no site access This site is used for purposes such as dirt bikes and all terrain vehicles

Probability to Score above 28 5 (after SI)
[ X ] High [ ] Medium [ ] Low

Priority For SI
[ X ] High [ ] Medium [ ] NFRAP

Comments The mine tailings on-site are known to contain a mean Pb content of 2,077 ug/g These tailings become easily air borne Also bottom feeding fish at the site and downstream from it have elevated Pb levels in their edible tissue A site investigation would characterize the contamination pathways more fully and aid in the HRS-II requirements for scoring

Concurrence
[ ] ESD [ ] SPFD

***** GROUND WATER ROUTE WORK SHEET ** **

| | Current Score | Highest Score | Ref | Comments |
|---|---|---|---|---|
| 1 OBSERVED RELEASE | 0 | 45 | | If monitoring well samples are positive for Pb contamination |
| 2 ROUTE CHARACTERISTICS | | | | |
| DEPTH TO AQUIFER OF CONCERN (2) | 6 | 6 | 3 | |
| NET PRECIPITATION | 2 | 2 | 4 | |
| PERMEABILITY OF UNSATURATED ZONE | 3 | 3 | 5 | |
| PHYSICAL STATE | 3 | 3 | 6 | Deposited as a slurry |
| ROUTE CHARACT SCORE = | 14 | 14 | | |
| 3 CONTAINMENT | 3 | 3 | 5,6 | Deposited directly on ground surface |
| 4 WASTE CHARACTERISTICS | | | | |
| TOXICITY/PERSISTENCE | 18 | 18 | 7 | Based on lead and cadmium |
| HAZARDOUS WASTE QUANTITY | 8 | 8 | 3 | 600 acres of tailings varying from |
| WASTE CHARACT SCORE = | 26 | 26 | | 0-100 feet thick |
| 5 TARGETS | | | | |
| GROUND WATER USE (3) | 9 | 9 | 2,11 | |
| DISTANCE TO NEAREST WELL/ POPULATION SERVED | 35 | 40 | 8 | If drinking water well is located closer to the site |
| TOTAL TARGETS SCORE = | 44 | 49 | | |
| GROUND WATER ROUTE SCORE = (57 330/100 factor) | 83 8 | 90 0 | | |

( ) Multiplier

SURFACE WATER ROUTE WORK SHEET

| | Current Score | Highest Score | Ref | Comments |
|---|---|---|---|---|
| 1 OBSERVED RELEASE | 45 | 45 | 9 | Based on sediment samples collected by the National Fisheries Research lab |
| 2 ROUTE CHARACTERISTICS | | | | |
| FACILITY SLOPE AND INTERVENING TERRAIN | | | | |
| 1yr 24hr RAINFALL | | | | |
| DISTANCE TO NEAREST SURFACE WATER (2) | | | | |
| PHYSICAL STATE | | | | |
| **ROUTE CHARACT SCORE =** | | | | |
| 3 CONTAINMENT | | | | |
| 4 WASTE CHARACTERISTICS | | | | |
| TOXICITY PERSISTENCE | 18 | 18 | 7 | Based on lead and cadmium |
| HAZ WASTE QUANTITY | 8 | 8 | 3 | 600 acres of tailings |
| **WASTE CHARACT SCORE =** | 26 | 26 | | |
| 5 TARGETS | | | | |
| SURFACE WATER USE (3) | 6 | 6 | 10 | |
| DISTANCE TO A SENSITIVE ENVIRONMENT (2) | 0 | 6 | | If a sensitive environment or species is determined |
| POPULATION SERVED/DISTANCE TO DOWNSTREAM WATER INTAKE | 0 | 0 | | |
| **TOTAL TARGETS SCORE =** | 6 | 12 | | |
| SURFACE WATER ROUTE SCORE = (64 350/100 factor) | 10 9 | 21 8 | | |

( ) Multiplier

* * AIR ROUTE WORK SHEET ***

| | Current Score | Highest Score | Ref | Comments |
|---|---|---|---|---|
| 1 OBSERVED RELEASE | 45 | 45 | 12,13 | Based on samples collected from tailings pile and photo documentation of wind blown dust |
| DATE AND LOCATION | | | | |
| 2 WASTE CHARACTERISTICS | | | | |
| REACTIVITY AND INCOMPATIBILITY | 1 | 1 | 7 | |
| TOXICITY (3) | 9 | 9 | 7 | Based on lead and cadmium |
| HAZARDOUS WASTE QUANTITY | 8 | 8 | 3 | 600 acres of loose tailings |
| **WASTE CHARACT SCORE =** | 18 | 18 | | |
| 3 TARGETS | | | | |
| POPULATION WITHIN 4 MILES | 21 | 21 | 14 15 | |
| DISTANCE TO SENSITIVE ENVIRONMENT (2) | 0 | 6 | | If sensitive environment or species is found near site |
| LAND USE | 3 | 3 | | Residential area near site |
| **TOTAL TARGETS SCORE =** | 24 | 30 | | |
| **AIR ROUTE SCORE =** (35 100/100 factor) | 55 4 | 69 2 | | |

( ) Multiplier

DRAFT

| CURRENT SCORE | S | $S^2$ |
|---|---|---|
| Groundwater Route Score ($S_{gw}$) | 83 8 | 7022 4 |
| Surface Water Route Score ($S_{sw}$) | 10 9 | 118 8 |
| Air Route Score ($S_a$) | 55 4 | 3069 2 |
| $S_{gw}^2 + S_{sw}^2 + S_a^2$ | | 10210 4 |
| $\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$ | | 101 0 |
| $\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1\,73 = S_M =$ | | 58 4 |

| HIGHEST SCORE | S | $S^2$ |
|---|---|---|
| Groundwater Route Score ($S_{gw}$) | 90 0 | 8100 0 |
| Surface Water Route Score ($S_{sw}$) | 21 8 | 475 2 |
| Air Route Score ($S_a$) | 69 2 | 4788 6 |
| $S_{gw}^2 + S_{sw}^2 + S_a^2$ | | 13363 8 |
| $\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$ | | 115 6 |
| $\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1\,73 = S_M =$ | | 66 8 |

FIT QUALITY ASSURANCE TEAM

DOCUMENTATION RECORDS
FOR
HAZARD RANKING SYSTEM

INSTRUCTIONS As briefly as possible summarize the information you used to assign the score for each factor (e g , "Waste quantity = 4,230 drums plus 800 cubic yards of sludges") The source of information should be provided for each entry and should be a bibliographic-type reference Include the location of the document

FACILITY NAME Big River Mine Tailings

LOCATION Desloge, Missouri

DATE SCORED March 17, 1988

PERSON SCORING Bob Overfelt

PRIMARY SOURCE(S) OF INFORMATION (e g , EPA region, state, FIT, etc )

Research reports prepared by the National Fisheries Research Laboratory in Columbia, MO, the University of Missouri - Rolla, the University of Missouri - Columbia and photo documentation of the site

FACTORS NOT SCORED DUE TO INSUFFICIENT INFORMATION

Fire and Explosion was not scored

COMMENTS OR QUALIFICATIONS

GROUND WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected (5 maximum)

No observed release cited to date

Rationale for attributing the contaminants to the facility

* * *

2 ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern (Ref 1, page 2, Ref 13)

There are two aquifers underlying a 0-100 feet layer of mine tailings In ascending order are the Bonneterre and the Lamotte Formations The Bonneterre is a light-gray to dark-brown dolomite that is fine to medium grained, glauconitic in places, contains thin shale beds and contains significant lead deposits in the form of galena (Pbs) The Lamotte is a sandstone conglomerate, quartzose, arkosic, and contains interbedded red-brown shale

Depth(s) from the ground surface to the highest seasonal level of the saturated zone [water table(s)] of the aquifer of concern (Ref 2)

This area is characterized by faulting This faulting may connect the surface, the Bonneterre, and the Lamotte Formations hydrologically The water table lies in the tailings (Ref 13 well logs) Therefore the minimal distance of 0 feet is assigned

Value = 3

Depth from the ground surface to the lowest point of waste disposal/ storage

The tailings pile ranges from 0-100 in thickness (Ref 3, page 1) The water table lies in the tailings (Ref 13) Therefore, the lowest point of waste disposal/storage from the ground surface is 0 feet

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal)

Mean annual precipitation is 42 86 inches (Ref 4, page 42)

Mean annual lake or seasonal evaporation (list months for seasonal)

Mean annual lake evaporation is 37 inches (Ref 4, page 63)

Net precipitation (subtract the above figures)

42 86 - 37 = 5 86 inches

Value = 2

Permeability of Unsaturated Zone

Soil type in unsaturated zone

The soils are formed in crushed dolomitic material (tailings) from lead mining The underlying material is light gray loamy fine sand, stratified by lenses of light brownish gray silt loam (about 10% mass) It is mildly alkaline throughout (Ref 5, Sheet Number 13, and Page 40)

Permeability associated with soil type
$1 \times 10^{-3}$ cm/sec

Permeability is rapid, most precipitation is absorbed into the surface Available water capacity is low (Ref 5, Page 40) Assigned value is 3 (Ref 18)

Value = 3

Physical State

Physical state of substances at time of disposal (or at present time for generated gases)

At the time of disposal the material was deposited as a tailings slurry (liquid) it is now a fine powder type material (Ref 6, Page 1)

Value = 3

* * *

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated

The tailings pile is uncovered and unstable (Ref 6, Page 3) The landfill has no liner and the material (tailings) underlying it is very permeable (Ref 5, Page 40)

Method with highest score

Tailings pile = 3
Landfill = 3

Value = 3

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated

| | Toxicity | Persistence | |
|---|---|---|---|
| Lead (Pb) | 3 | 3 | (Ref 7, Page 1688-1689, Ref 18) |
| Zinc (Zn) | --- | 3 | (Ref 7, Page 2751, Ref 18) |
| Cadmium (Cd) | 3 | 3 | (Ref 7, Page 610, Ref 18) |

Compound with highest score

Lead and cadmium (Ref 7)

Value = 18

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum)

This is a massive pile of mine tailings that covers more than 600 acres and is from 0-100 feet deep (Ref 3, Page 1)

Basis of estimating and/or computing waste quantity

Site consists of 500 acres of mine tailings containing lead, cadmium and zinc and are 0-100 feet in thickness (Ref 3, Page 1) This obviously exceeds the maximum waste quantity of 2,500 cubic yards

* * *

5 TARGETS

Ground Water Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility

The Bonneterre aquifer and Lammotte aquifer are used for drinking water (Ref 2) The Flat River Water District well in Desloge pumps from 402 feet in the Lammotte Formation (Ref 11) This water district provides drinking water for the towns of Desloge, Elvin, Flat River, Leadington, River Mines, and Ester

Value = 3

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply

The municipal well in Desloge is located between Locust and Poplar Streets The well is part of the Flat River Water District (Ref 8)

Distance to above well or building

Between 2,000 feet and 1 mile (Ref 16)
Approximately 3,000 feet

Population Served by Ground Water Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each

Population served in Flat River Water District is approximately 12,000 (Ref 8)

Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1 5 people per acre)

None known (Ref 10)

Total population served by ground water within a 3-mile radius

12,000 (Ref 8)

Value = 35

## SURFACE WATER ROUTE

### 1 OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum)

Lead (Pb) has been detected at slightly elevated levels at the site and four miles down river (Ref 9, Pages 20 and 21) Also the sediments on the bottom of the river have been changed drastically in a physical and chemical manner (Ref 9) Collapse of mine tailings has been documented This sampling was done by the National Fisheries Research Laboratory in 1982

Sediment Samples
Background 49 6 ug/g Pb
Downstream from site 2,215 ug/g Pb
(Ref 9, Pages 67-70)

Rationale for attributing the contaminants to the facility

Tests of the Big River bottom sediment have proven that a major release of Pb, Zn, and Cd rich tailings into the river in 1977 have elevated the contents of Pb in both the surface water and bottom sediment Cd and Zn are elevated in the bottom sediment (Ref 9)

Water Samples (Dissolved Pb)
Background 0 005 mg/l Pb
Downstream from site 0 020 mg/l Pb
(Ref 9, Pages 20-21)

Value = 45
* * *

### 2 ROUTE CHARACTERISTICS

Facility Slope and Intervening Terrain

Average slope of facility in percent

Name/description of nearest downslope surface water

Average slope of terrain between facility and above-cited surface water body in percent

Is the facility located either totally or partially in surface water?

Is the facility completely surrounded by areas of higher elevation?

1-Year 24-Hour Rainfall in Inches

Distance to Nearest Downslope Surface Water

Physical State of Waste

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated

Method with highest score

4 WASTE CHARACTERISTICS

Toxicity and Persistence

| Compounds(s) evaluated | Toxicity | Persistence | |
|---|---|---|---|
| Lead (Pb) | 3 | 3 | (Ref 7, Pages 1688, 1689, Ref 18) |
| Zinc (Zn) | --- | 3 | (Ref 7, Page 2751, Ref 18) |
| Cadmium (Cd) | 3 | 3 | (Ref 7, Page 610, Ref 18) |

Compound with highest score

Lead and cadmium (Ref 7)

Value = 18

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum)

The site is a massive pile of mine tailings rich in Pb, Cd, and Zn that covers more than 600 acres and varies in thickness from 0-100 feet thick (Ref 3, Page 1)

Basis of estimating and/or computing waste quantity

See Ground Water Route

Value = 8

* * *

5 TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance

Recreational uses include fishing, boating, and swimming Other uses include livestock watering and wildlife watering (Ref 10) It is also known that the bottom feeding fish at the Desloge site and for miles downstream have elevated levels of Pb in their edible tissue Samples consistently exceed the World Health Organization (WHO) dietary limit of 0 3 ug/lg (Ref 9, Page 110) In 1980, the Missouri Department of Conservation issued a press release cautioning local residents against eating fishes because of high Pb residues (Ref 9, Page 1)

Is there tidal influence?

No

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less

None (Ref 17)

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less

None known (Ref 17)

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less

None (Ref 17)

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake

There are no intakes within 3 stream miles of site (Ref 19)

Value = 0

Computation of land area irrigated by above-cited intake(s) and conversion to population (1 5 people per acre)

There are no intakes within 3 stream miles of the site

Value = 0

Total population served

0

Value = 0

Name/description of nearest of above water bodies

The Big River is the nearest perennial water body It borders the site on the west, north, and east sides

Distance to above-cited intakes, measured in stream miles

The nearest intake is greater than 3 miles downstream from the site (Ref 19)

AIR ROUTE

1 OBSERVED RELEASE

Contaminants detected

The mine tailings at the Desloge tailing pile have been sampled and are known to be rich in Pb, Cd, and Zn (Ref 12, Pages 28-30) Mean concentrations were Pb 2,077 ug/g, Cd 26 ug/g, and Zn 1,226 ug/g A control soil sample was taken for the same study which contained much less Pb than the tailings The control sample was taken 1 mile north of Farmington, Missouri approximately 8 miles from the site (Ref 12, Page 73 and 75)

Date and location of detection of contaminants

During a reconnaissance of the site on January 25, 1988, photo documentation was conducted It is evident from the photographs taken and from E & E/FIT observations that a significant amount of tailings were air borne and that a plume existed for at least 1 mile to the southeast of the site (Ref 13, Appendix C)

Methods used to detect the contaminants

Based on past sampling of tailings material and photo documentation of its ability to become easily air borne

Rationale for attributing the contaminants to the site

It has been determined by laboratory analyses that the tailings on-site contain substantial amounts of Pb, Cd, and Zn It has also been determined by photo documentation that these tailings become easily air borne (Ref 12 Page 21 of 36)

Value = 45

* * *

2 WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound

Cd, Pb, and Zn and all a moderate fire hazard when in the dust form and exposed to flame (Ref 7, Pages 610, 1,688, 1,689, 2,751)

Value = 1

Most incompatible pair of compounds

Zn and Cd are stated to be incompatible but do not pose an immediate hazard (Ref 7, Page 2,751)

Value = 1

Toxicity

Most toxic compound

Lead (Ref 7, Page 1,688, 1,699)

Value = 3

Hazardous Waste Quantity

Total quantity of hazardous waste

Same as Ground Water Route and Surface Water Route

Value = 8

Basis of estimating and/or computing waste quantity

Same as Ground Water Route

* * *

3 TARGETS

Population Within 4-Mile Radius

Circle radius used, give population, and indicate how determined

0 to 4 mi 0 to 1 mi 0 to 1/2 mi 0 to 1/4 mi

Towns within a 4 mile radius of the site include Desloge - 3,844, Flat River - 4,521, Elvins - 1,770, Bonneterre - 4,320, Leadwood - 1,340, Total population - 15,465 (Ref 14, 15 and 4-mile radius map)

Value = 21

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less

Not applicable (Ref 16)

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less

None known (Ref 16)

Distance to critical habitat of an endangered species, if 1 mile or less

None (Ref 17)

Value = 0

Land Use

Distance to commercial/industrial area, if 1 mile or less

The site is approximately one-half mile from the business district of Desloge, Missouri (Ref 4-mile radius map)

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less

> 2 miles (Ref 16, 4-mile radius map)

Distance to residential area, if 2 miles or less

The site is within 1/4 mile of a residential area (Ref 4-mile radius map)

Value = 3

Distance to agricultural land in production within past 5 years, if 1 mile or less

Prime farmland exists within 1/4 mile of the site (Ref 5, page 45)

Distance to prime agricultural land in production within past 5 years, if 2 miles or less (Ref 5, page 45)

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

(Ref 20)

FIRE AND EXPLOSION
NOT SCORED

1 CONTAINMENT

Hazardous substances present

Type of containment, if applicable

* * *

2 WASTE CHARACTERISTICS

Direct Evidence

Type of instrument and measurements

Ignitability

Compound used

Reactivity

Most reactive compound

Incompatibility

Most incompatible pair of compounds

* * *

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility

Basis of estimating and/or computing waste quantity

* * *

3 TARGETS

Distance to Nearest Population

Distance to Nearest Building

Distance to Sensitive Environment

Distance to wetlands

Distance to critical habitat

Land Use

Distance to commercial/industrial area, if 1 mile or less

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less

Distance to residential area, if 2 miles or less

Distance to agricultural land in production within past 5 years, if 1 mile or less

Distance to prime agricultural land in production within past 5 years, if 2 miles or less

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

Population Within 2-Mile Radius

Buildings Within 2-Mile Radius

## DIRECT CONTACT

1 OBSERVED INCIDENT

Date, location, and pertinent details of incident

* * *

2 ACCESSIBILITY

Describe type of barrier(s)

There are no fences around the site It could be easily accessed (Ref 13, Appendix C Photos) The area is used by recreational vehicles (i e dirt bikes, ATV) (Ref 3, Page 2)

Value = 3

* * *

3 CONTAINMENT

Type of containment, if applicable

The site is uncontrolled piles of mine tailings (Ref 13, Appendix C Photos) Employees of the on-site landfill work on the pile everyday Because of the easy access, all terrain vehicles are also used for recreation on site (Ref 3, Page 2)

Value = 15

* * *

4 WASTE CHARACTERISTICS

Toxicity

Compounds evaluated

Pb, Cd, and Zn

Compound with highest score

Lead (Ref 7, Pages 1,688 and 1,689)

Value = 3

* * *

## 5 TARGETS

### Population within one-mile radius

The approximate population within a one-mile radius is 4,000 (Ref 4-mile radius map and Ref 14)

Value = 4

### Distance to critical habitat (of endangered species)

None (Ref 17)

Value = 0

HRS DOCUMENT LOG SHEET

SITE NAME Big River Mine Tailing
CITY Desloge STATE Missouri
IDENTIFICATION NUMBER #FMOO616PA

| REFERENCE NUMBER | DESCRIPTION OF REFERENCE |
|---|---|
| 1 | Guidebook to the Geology and Ore Deposits of the St Francois Mountains, Missouri, 1981 MDNR Division of Geology and Land Survey |
| 2 | Miller, Don, March 1, 1988, Personal Communication, Missouri Geologic Survey, Geologist |
| 3 | Emergency Action Plan for Lead Mine Tailings, Desloge, Missouri, 1981 MDNR |
| 4 | Climatic Atlas of the United States, 1979, U S Department of Commerce |
| 5 | Soil Survey of St Francois County, Missouri, August 1981, National Cooperative Soil Survey |
| 6 | Novak, J , Hasselavander, G January 1980, Control of Mine Tailing Discharges to Big River, University of Missouri - Columbia |
| 7 | Sax, N Irving, 1984 Dangerous Properties of Industrial Materials 6th Ed |
| 8 | Johnson, Dennis, March 1, 1988, Personal Communication Asst Manager Flat River Water District |
| 9 | Schmitt, C Finger, S , September 1982, The Dynamics of of Metals From Past and Present Mining, National Fisheries Research Laboratory |

HRS DOCUMENT LOG SHEET SITE NAME Big River Mine Tailing
CITY Desloge STATE Missouri
IDENTIFICATION NUMBER #FM00616PA

| REFERENCE NUMBER | DESCRIPTION OF REFERENCE |
|---|---|
| 10 | Howard, John, March 1, 1988, Personal Communication MDNR |
| 11 | Johnson, Dennis, December 2, 1987, Personal Communication |
| | Asst Manager Flat River Water District |
| 12 | Wixson, B , et al , A Study on the Possible Use of Chet |
| | and Tailings from the Old Lead Belt of Missouri for |
| | Agricultural Limestone, University of Missouri - Rolla |
| | December 1983 |
| 13 | Preliminary Assessment of the Big River Mine Tailings |
| | Site, E & E/FIT, TDD#F-07-8711-039, PAN #FM00616PA |
| | March 1988 (Photographs Appendix C) |
| 14 | U S Census Bureau, December 2, 1987, Personal |
| | Communication, 1100 hours |
| 15 | U S Census Bureau, December 2, 1987, Personal |
| | Communication, 1515 hours |
| 16 | Topo Map |
| 17 | Dickneite, Dan, March 18, 1988, Personal Communication, |
| | Missouri Department of Conservation |
| 18 | Uncontrolled Hazardous Waste Site Ranking System, A Users |
| | Manual, July 16, 1982 |
| | |

HRS DOCUMENT LOG SHEET SITE NAME Big River Mine Tailing
CITY Desloge STATE Missouri
IDENTIFICATION NUMBER #FMOO616PA

| REFERENCE NUMBER | DESCRIPTION OF REFERENCE |
|---|---|
| 19 | Howelovd, John, March 24, 1988, Personal Communication, Missouri Department of Natural Resources |
| 20 | King, Carol, March 24, 1988, Personal Communication, Flat River Chamber of Commerce |
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